

AN EVALUATION OF THE C-E COST ALLOCATION ALGORITHMS
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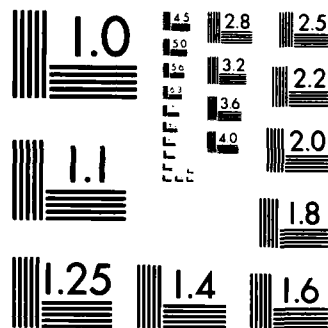
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II: UNIT LEVEL CONSUMPTION

by

Arlene R. Munson
Patricia H. Weber
Robert L. Gardner
Gregory J. Zunic

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Applied Research in Statistics - Mathematics - Operations Research

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EXECUTIVE SUMMARY

This report by Desmatics, Inc. is the second in a series of volumes which review procedures used by the Communications-Electronics (C-E) subsystem of VAMOSC, the Air Force Visibility and Management of Operating and Support Cost System, to allocate operating and support costs to ground communications and meteorological equipment at the Type Model Series (TMS) level. It deals specifically with evaluations of the algorithms and inputs for the three subcategories of costs under Unit Level Consumption: Utilities, Fuel, and Maintenance Materiel.

Within the C-E system the term utilities refers only to electricity. However, as commonly used, the word "utilities" refers to other things besides electricity. Desmatics therefore recommends renaming this category "Electric Utilities" and redefining it to emphasize that only costs of purchased or centrally produced electricity are included. Since these are computed costs rather than actual, it is critical that they be computed accurately. At present they are based on reported base utility rates, on consumption data from technical orders, and on the assumption that all C-E equipment operates continuously. Desmatics recommends verifying the accuracy of both the consumption figures and the continuous operation assumption by collecting samples of actual data.

The C-E system has not been receiving electric utility rates for all locations where C-E equipment is used. There is currently no method for determining whether the missing rates apply to bases for which the C-E system requires rates, or to remote sites which do not rely on centrally produced power. Desmatics proposes a means to identify remote sites,

thereby in turn permitting the identification of C-E organizations for which utility rates are required, and suggests ways of supplying rates for these organizations.

Fuel costs are currently defined as "the cost of fuel for operating C-E end items." In actuality, the costs of a C-E organization's other fuels (e.g., vehicle fuels) are also included. Desmatics recommends broadening the definition to include all unit fuels.

The C-E system presently allocates fuel costs only to mobile equipment, using a two stage method which allocates costs to generators and then to the TMSs which use the generators. Desmatics contends that fuel costs should be allocated to equipment at remote and regular sites, as well as to mobile equipment, and proposes a one step algorithm for allocating fuel costs directly to end items.

Most of the maintenance materiel costs for the C-E system, which are provided by the Standard Base Supply System, D002A, are currently being lost. The Office of VAMOSC has determined that this is due primarily to the fact that the interface with D002A omitted all transactions with three Type Organization Codes commonly used by C-E organizations. These records are further identified for VAMOSC by Standard Reporting Designator (SRD); transactions for expensed indirect materiel do not have assigned application SRDs and are therefore not selected. Desmatics suggests a method for collecting and allocating these indirect materiel costs; they can then either be included in the maintenance materiel cost category or reported separately.

The C-E system processing of maintenance materiel costs needs to be modified to insure that total, rather than unit, investment TCTO kit

materiel costs are obtained. In addition, Desmatics recommends including these costs with depot-level modification kit materiel costs in the Replacement Investment category.

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I. INTRODUCTION

Desmatics, Inc., under Contract No. F33600-82-C-0466, is conducting an evaluation of the cost allocation algorithms employed in the Communications-Electronics (C-E) Subsystem (D160A) of VAMOSC, the Air Force Visibility and Management of Operating and Support Costs System. This report is the second in a set of volumes which discuss the scope and findings of the Desmatics evaluation efforts.

The purpose of this volume is to evaluate procedures for allocating the following Unit Level Consumption costs to C-E end items at the Type Model Series (TMS) level: Utilities, Fuel, and Maintenance Materiel. This report consists primarily of a qualitative examination which evaluates the face validity of the C-E system logic. It evaluates the reasonableness of the procedures used for selecting, calculating, and allocating the above-mentioned costs to TMSs, assessing whether they may be expected to provide equitable results. Quantitative evaluations are included where appropriate. Desmatics has made a number of specific recommendations which are enumerated in Section VI of this report. The corresponding responses and comments of the Office of VAMOSC accompany each recommendation.

The Statement of Work under which this Desmatics study was initiated calls for the evaluation of the C-E system algorithms as set forth in the draft of the C-E User's Manual dated 1 July 1981. The current edition of this manual, AFR 400-31, Volume III, dated 12 August 1982, was used for the evaluations in this volume. The C-E system has evolved almost continually since its inception, reflecting improvements that were made

in virtually every aspect of the system prior to the first production runs in September 1982. Additional modifications and enhancements have been made for the second run and more are planned for the immediate future.

Desmatics recognizes that to restrict its evaluation to the July 1981 baseline would significantly limit the usefulness of its findings. Accordingly, Desmatics has kept pace with the evolution of the C-E system and has attempted to reflect the significant system changes, specifically in those instances where a given cost was computed by different algorithms in two years. As a result, the documentation of Desmatics' findings is more complex than might otherwise be the case. For clarification, relevant portions of the discussions are specifically identified to the fiscal years to which they apply.

Desmatics has endeavored to have this volume reflect the current status of the Unit Level Consumption cost allocation algorithms within the C-E system. The authors feel that this has been accomplished. However, the reader must realize that should future C-E system changes impact on the algorithms discussed, portions of this report may become outdated.

II. BACKGROUND

Unit level consumption includes the following three subcategories of costs: Utilities, Fuel, and Maintenance Materiel. Within the system, utilities costs are defined [12] as the cost of electricity consumed by C-E end items worldwide. Included are costs of purchased or centrally produced electrical power. Fuel costs are for fuel required in the normal operation of selected C-E end items, primarily mobile equipment and equipment at remote sites. Maintenance materiel costs are the cost of materiel consumed in the base corrective maintenance of C-E end items at all organizations worldwide.

Since C-E equipment is not separately metered, electric utility costs for end items are computed from technical order power consumption data and reported base utility rates. Fuel costs are collected at the organizational level and allocated to end items in an organization's inventory. Maintenance materiel costs are collected and reported directly by Standard Reporting Designator (SRD). The processes used in the determination of each of these costs for each TMS worldwide are described in the following source documents:

- (1) AFR 400-31, Vol. III, C-E User's Manual [12],
 - (2) C-E System Specification D160A [2],
 - (3) Subsystem Specification of the Preprocessor (VAMOH) [4,5],
 - (4) C-E User/Final Operational Evaluation (FOE) Conference Handouts, 1983 [3],
 - (5) Relevant Data Automation Requirements,
- and (6) AFM 177-206, Automated Materiel System Interfaced with Supply System at Base Level User's Manual [8].

The two types of C-E equipment ownership situations discussed in Volume I of this series [14], one involving organizations which are primarily C-E mission oriented, the other involving organizations in which the C-E function is incidental to the primary mission, affect some of the allocation algorithms discussed in this volume. Desmatics termed these two kinds of organizations "C-E" and "non-C-E" respectively [14]; this terminology is also used in this volume.

Each cost category under Unit Level Consumption is discussed in a separate section. These sections include a description of the process used in determining the cost attributable to each TMS, an evaluation of the face validity of the process, and a review of the appropriateness of the input data sources. An additional section summarizes the conclusions and recommendations made by Desmatics based on its study of the determination of C-E Unit Level Consumption costs. Replies from the Office of VAMOSC are also included.

III. UTILITIES

The C-E system defines Utilities cost as the "cost of electricity consumed by a C-E end item (TMS) at all organizations at all base utility rates. Since the costs of electricity for C-E end items are not separable in any cost collection system, they are calculated using Order (TO) power requirements, organizational inventories of TMS base utility rates.

A. PROCESS DESCRIPTION

The following description is based on information from the VAMOSC. It does not correspond exactly to the description in C-E User's Manual but reflects the actual processing. In order to compute the electricity costs for a TMS at the worldwide level, the cost of electricity consumed by a given TMS (as defined by NSN) C-E organization is calculated as follows:

$$u = Q \times C \times R$$

where u = the cost of electricity for each end item by NSN (National Stock Number) at each organization,

Q = the organization's quantity of the NSN from the Equipment Item Requirements Computation System (D039), from records designated as Format 100 records.

C = the annual electrical power consumption of the NSN, from information from FOS,

and R = the corresponding base utility rate from F006, Command Engineering and Military Family Housing Cost System. Engineering Cost Account Codes 21020, purchased electricity or 26000, electric generating plants).

The Air Force-wide utility cost for a TMS is the sum of the above costs for all NSNs corresponding to a given TMS for all C-E organizations.

For FY81 electric utility costs were calculated for all C-E end items. For FY82 this algorithm was used to calculate electric utility costs for equipment which has a zero in the fuel factor field of the Unit TMS Factor Table (i.e., nonmobile equipment). As pointed out in the C-E User's Manual there are currently no data systems which record the actual operating time for TMSs; therefore the algorithm is based on the assumption that all TMSs operate 24 hours per day, 365 days per year (i.e., 8760 hours per year). An implied assumption is that the standard operating kilowatt hours, as stated in TOs and submitted to the Office of VAMOSC by depot personnel, provide an accurate measure of the actual electrical power consumed by the TMS.

B. EVALUATION

The utilities algorithm is designed to provide the cost of electricity for operating C-E end items. It is not used to allocate actual costs to end items as is done with most of the C-E system's algorithms, but is used to calculate electric utility costs for each relevant TMS using power requirements and base utility rates.

1. Definition of Utilities Costs

Utilities is a misnomer for this cost category, since the word util-

ities commonly includes such things as water, sewage, and heating. Also, the definition of this cost category needs to be modified to reflect the fact that it does not include the cost of electricity produced by a C-E organization's own generators. Therefore, Desmatics suggests renaming the cost category "Electric Utilities," and redefining this cost as the cost of purchased or centrally produced electricity consumed by a TMS at all organizations at all bases.

2. The 24-Hour Operating Time Assumption

While the assumption that all C-E equipment runs 24 hours, 365 days a year may be accurate in many cases, this assumption will cause an over-estimation of utility costs for items that do not run continuously. For example, backup equipment is generally not operating at full power. Currently there are no systems which report the operating times for C-E equipment; therefore the Office of VAMOSC should conduct a study to collect data from C-E organizations to determine the number of end items (by NSN) normally operating, and the average number of hours per day and days per year these NSNs operate. It is necessary to collect this data by end item NSN since different models of a given TMS may be assigned separate NSNs which have different power requirements. After collecting operating time data for one year, a decision could be made as to the validity of the 24-hour assumption for fixed equipment. If the assumption is upheld there would be no need to continue collecting this information. However, for any situation where the 24-hour, 365 day a year operating time assumption is not true, actual operating times should

be collected yearly on the C-E Unit Level Report (RCS:HAF-LEY(A)8119) and incorporated into the electric utility algorithm as follows:

$$u = Q_o \times C \times R \times T$$

where Q_o = the quantity of the end item (NSN) normally operating at a given organization,

and T = the average fractional part of a year that the NSNs are operating using purchased or centrally produced electricity. For example, for a 16 hr/day, 260 day/yr operation:

$$T = \frac{16}{24} \times \frac{260}{365} = \frac{4160}{8760} = .475$$

The variables u , Q , C , and R are the same as defined previously. Default values of $T=1$ (24 hours, 365 days per year), and $Q_o = Q$ could be assumed so that only the significant exceptions would have to be entered into the system.

3. Mobile Equipment

In the case of mobile equipment the situation is further complicated. While mobile equipment is powered by generators when it is in the field, it may be run on purchased or centrally produced electricity when it is in garrison. For FY81 mobile equipment was not treated differently from fixed equipment; therefore, its utility costs were calculated assuming a 24 hour running time. For FY82 fuel costs, but not electricity costs, were calculated for mobile equipment. The true picture, however, involves a combination of the two approaches. To compute electricity costs for mobile equipment, the number of hours it operates

using purchased or centrally produced electricity would have to be reported in the VAMOSC C-E Unit Level Report and included in the electric utility cost algorithm as described above.

4. Technical Order Power Requirements

Power requirements are manually entered into the TMS-NSN Table by the Office of VAMOSC. For FY81 and FY82 these values were provided by personnel at the Sacramento Air Logistics Center and the Office of VAMOSC from TO data. It is obvious that some of the power values in The TMS-NSN Table used for these runs are not correct. For example, many values are zero and many are 99999 (possibly because this is the largest number that would fit in the original 5 position field that for FY82 has been increased to 10 positions). For some weather equipment the power requirement is for a component, not for the end item. This will result in an incorrect quantity for the TMS but will not affect the utility algorithm. Where no power requirement data is supplied, other methods will have to be used to obtain this information.

The Office of VAMOSC should determine what standards are used in developing TO power requirements for C-E equipment. These power requirements must represent normal average operating conditions, not peak power, for accurate computation of these costs. For example, for transmitting/receiving equipment the power consumption value must reflect the average time the equipment is transmitting (using more power), versus receiving (using less power).

The Office of VAMOSC should confirm that TO power requirement values are suitable for computing electric utility costs for TMSs. For any TMSs where these values do not appear to be suitable, actual power consumption figures could be obtained by metering the equipment under normal operating conditions. This method could also be used when TO information is missing. Power requirements normally would not change from year to year, so once accurate values are obtained, the only changes would be for the addition of new TMSs, or new NSNs for existing TMSs.

5. Base Utility Rates and Identification of Remote Sites

The last variable in the utilities cost allocation algorithm is the base utility rate (unit cost) which comes from F006. For FY81 and FY82 rates for some bases were missing, resulting in zero utility costs for the TMSs at these bases. In the case of organizations at remote sites, where the equipment is powered by generators, the utility rate should be zero. No costs for electrical utilities should be computed for these sites, but fuel costs for their generators should be included on the C-E Operating and Support Cost Report. Fuel costs for remote sites will be discussed further in the fuel section of this report. All nonremote locations should have reported utility rates, but for various reasons this is not always so. The problem is to distinguish between remote sites and those nonremote sites for which rates are missing.

Currently the C-E system does not specifically identify remote sites. Desmatics suggests that the first step should be to search D039

files for organizations which own generators but do not own mobile equipment. The status of these selected organizations should then be verified by the Office of VAMOSC to ensure that their equipment does in fact operate on power produced by the units' generators. Normally this should be a one time process except for the addition of new organizations. A field could then be added to the PAS-Organization Table to flag these sites.

Once all the remote sites are identified, the remaining sites should all have utility rates. An estimated utility rate should then be inserted in the Base Utilities Rates file for any nonremote sites with missing or zero rates. A possible estimate for a base's missing electric utility rate would be the rate of the nearest base with a reported rate. This could be the rate of the parent installation identified in the USAF Installations Directory [10]. Alternatively, as pointed out by the Office of VAMOSC, the average rate of all organizations with the same first two letters of their Personnel Accounting Symbol (PAS) could be used, since they will often be located in the same geographical area. For example, organizations with PAS ATxxxxxx are all located in Guam. Either of these methods or a combination of the two could be automated and would insure against missing rates.

There is one special case where utility rates are missing. This is where a USAF C-E organization is located on a non-USAF base (e.g., Army, Navy) but is not remote in the sense that it uses generators for powering its equipment. Such organizations use electricity supplied by the host base. The utility rate for those host bases will be missing since F006, being a USAF system, has no utility rates for non-USAF bases.

Therefore, an estimated electric utility rate must be used for these organizations, but one based on PAS may not be accurate since these sites may not be located near others in their PAS groups.

Desmatics recommends that the Office of VAMOSC first attempt to insert estimated base utility rates manually for organizations located at non-USAF bases. It should then use an automated method as previously described to insure against any missing base rates.

6. Display of Power Requirements

The C-E Operating and Support Cost Report displays the Air Force-wide cost of utilities for each TMS. This cost reflects the varying base utility rates used. Desmatics suggests that the TMS electrical consumption rate employed in the utility cost calculation be included on the Operating and Support Cost Report as an additional, useful piece of information.

Alternatively the Office of VAMOSC might consider using the consumption rate as a substitute for electric utility costs. Electric utility costs should then be included, but without separate visibility, in RPM costs.

IV. FUEL

Fuel costs are defined in AFR 400-31, Vol. III, as the "cost of fuel for operating a C-E end item (TMS) at all C-E organizations at all bases" [12]. These costs are further described as being for selected equipments requiring fuel i.e., for mobile equipment and equipment at remote sites. C-E end items do not use fuel directly, but indirectly through fuel-consuming generators. The FY82 fuel algorithm is used only to allocate fuel costs for mobile equipment, not for equipment at remote sites.

A. PROCESS DESCRIPTION

Fuel costs are collected at the Operating Agency Code/Operating Budget Account Number (OAC/OBAN) level, allocated to an organization's TMSs, and then summed by TMS to the Air Force-wide level. Fuel costs are reported in the Accounting and Budget Distribution System (H069R). The VAMOSC preprocessor (VAMOH) system processes this file to produce the C-E Accounting System for Operations (ASO) Extract File. To obtain fuel costs, the C-E system then selects records with Responsibility Center/Cost Center (RC/CC) Codes of xx26xx, xx35xx, or xx38xx, and Element of Expense/Investment Codes (EEICs) of 612, 641, 642, 693, and 699. EEIC 612 is used for oil and lubricants, EEIC 641 is used for motor and diesel fuel for heating and power production, EEIC 642 is used for motor and diesel fuel for all uses except heating and power production, EEIC 693 is used for aviation POL for other than flying requirements (e.g., JP4

fuel for turbine generators), and EEIC 699 is used for aviation POL for flying requirements [11]. The C-E system then sums the costs for each OAC/OBAN.

Fuel costs for a TMS at organizations with a given OAC/OBAN are calculated as the product of the total fuel costs for that OAC/OBAN and the TMS fuel factor. For FY81 the fuel factors for a TMS, one for each owning organization, were calculated as follows:

$$F_u = \frac{F_i \times Q_i}{(F_1 \times Q_1) + (F_2 \times Q_2) + \dots + (F_n \times Q_n)}$$

where F_u = the portion of the organization's fuel costs attributable to TMS_i ,

F_i = fuel consumed by TMS_i per 24-hour period from TOs,

and Q_i = organization's inventory of TMS_i from D039 Format 100 records.

Since no TMS selected by the C-E system uses fuel directly, the fuel factors were undefined which resulted in zero fuel costs for all TMSs for FY81.

For FY82 a different algorithm was developed to allocate fuel costs for mobile equipment. The fuel factor for a mobile TMS is developed as follows:

- (1) Select generators from the D039 file by matching NSNs with those on the Fuel Information File (a file created by the Office of VAMOSC listing generators by NSN and their fuel consumption rates from TOs).
- (2) For the selected generators, calculate their fraction of the organization's fuel as follows:

Hourly fuel consumption, all Type k generators, this organization
Hourly fuel consumption, all generators, this organization

This ratio is based on the assumption that all generators operate the same amount of time.

- (3) Using the TMS-Generator Table, a table created by the Office of VAMOSC which relates TMSs to generators, calculate a fraction which represents the share of a generator type required by all units of a given TMS at this organization:

$$f_k = \frac{g_k \times J}{G_k}$$

where f_k = fraction of all Type k generators at an organization required by all units of TMS_j at the organization,

g_k = number of Type k generators required by one unit of TMS_j,

J = organizational inventory of TMS_j,

and G_k = organizational inventory of Type k generators.

This ratio is based on the assumption that all TMSs operate the same amount of time.

- (4) Multiply the fractions from steps 2 and 3 to get the TMS Raw Fuel Factor.
- (5) Obtain the Final Fuel Factor by combining Raw Factors where there is not a one-to-one relationship between generators and TMSs.

Fuel costs for an organization with mobile equipment are selected by OAC/OBAN, then multiplied by the TMS fuel factor to get the fuel costs for a given TMS at that organization. The Air Force-wide fuel cost for a TMS is the sum of its fuel costs at all organizations.

B. EVALUATION

This evaluation discusses the selection of fuel costs and the means

of allocating them to end items. It should be noted that the fuel costs being discussed are costs for fuel used indirectly by TMSs. Since only fuel costs for mobile equipment are currently being allocated, Desmatics suggests means for allocating fuel costs for all C-E equipment. Desmatics also suggests ways to simplify the fuel factor calculations for mobile equipment.

1. Definition of Fuel Costs

The fuel costs selected by the C-E system for allocation to TMSs include various types of fuel used for purposes other than the operation of C-E equipment. For example, cost records with EEIC 642 are for fuel used to operate an organization's vehicles. All of a C-E organization's fuel costs are legitimately allocable to C-E end items. The costs for fuel not used to power C-E end items could be reported separately; however, this is not recommended since they do not constitute a major cost. Desmatics agrees with the current treatment of these costs but recommends changing the definition of the fuel cost category from the "cost of fuel for operating a C-E end item" to "the allocated cost of fuel and lubricants used by a C-E organization."

2. Proposed Fuel Algorithm

The FY82 method of allocating fuel costs to mobile equipment employing a TMS-Generator Table and Fuel Information File is complex and

has several possible problems. The TMS-Generator Table, which identifies TMS-generator relationships, is difficult to build since a TMS can use many different generators and possibly fractions of generators for its power requirements. Also, the algorithm does not take into account the different costs of the various types of fuel used by the generators. If an organization has more generators (possibly for backup) than the TMS-Generator Table indicates are required for the organization's TMSs, the portion of the allocated fuel costs for these generators will be lost. In order to allocate fuel costs correctly, generators owned by an organization and used exclusively by TMSs not in the TMS-NSN Table must be included in the Fuel Information File. This was not considered for FY82. In addition, fractional values were not used in the TMS-Generator Table to indicate when a generator is shared by TMSs. This resulted in an overestimation of fuel costs for these TMSs for FY82.

In Desmatics' opinion the Fuel Factors produced by the FY82 algorithm are not accurate. For example, most fuel factors in the FY82 Unit TMS Factor Table will allocate less than ten percent of the associated organizations' fuel costs to TMSs in the TMS-NSN Table, and many are zero.

It should be noted that fuel costs are collected by OAC/OBAN, but the fuel allocation factor is calculated for an organization. Since generally more than one organization with C-E equipment will have the same OAC/OBAN, double-costing may occur.

For the above reasons, Desmatics suggests the following algorithm for allocating fuel costs to mobile equipment:

$$C_i = c \times F_i$$

where C_i = allocated fuel costs for a given NSN (end item) owned by all organizations within a given OAC/OBAN,

c = total fuel costs for that OAC/OBAN,

and F_i = the mobile NSN fuel factor.

The mobile NSN (end item) fuel factor is defined by:

$$F_i = \frac{U_i \times Q_i}{(U_1 \times Q_1) + (U_2 \times Q_2) + \dots + (U_n \times Q_n)}$$

where U_i = electric consumption rate from TOs for mobile NSN_i,

Q_i = inventory of mobile NSN_i for all organizations within a given OAC/OBAN,

and n = total number of types of mobile NSNs for all organizations within the OAC/OBAN (including NSNs not in the TMS-NSN Table).

The worldwide fuel cost for a TMS is the sum of the allocated costs for the corresponding NSNs. This algorithm is based on two assumptions:

- (1) The organization's TMSs all operate an equal amount of time while using generators.
- (2) Generators are universal and therefore any generator can be used to power any TMS.

The first assumption could be tested using a method similar to that recommended previously for testing the 24-hour operating time assumption for equipment powered by purchased or centrally produced electricity. The algorithm could easily be modified to include actual operating times if the equal operating time assumption proves to be invalid. As used here, consistently high or low electric consumption rates would not affect the fuel cost allocation. While the second assumption is not always true, in Desmatics' opinion this does not invalidate the use of

the algorithm.

The proposed algorithm can also be used to allocate fuel organizations at remote and other sites. For organizations with mobile equipment the algorithm would be changed to include all not just mobile NSNs. The Office of VAMOSC has suggested that organizations with both fixed and mobile equipment all fuel costs go to the mobile equipment, as this type of equipment would use the fuel. Desmatics agrees with this suggestion. It should be noted that this allocation ratio should only be used to allocate fuel for C-E organizations, not all organizations with C-E equipment. Most of the fuel at non-C-E organizations is consumed in support of non-C-E activities.

V. MAINTENANCE MATERIEL

Maintenance materiel cost is defined as the "cost of materials consumed in the performance of base corrective maintenance for each C-E end item (TMS) at all C-E organizations at all bases. Materiel includes non-reparable or reparable items that are not centrally managed with individual item reporting. It excludes reparables procured from the stock fund which are included in cost elements for replenishment spares" [12]. Time Compliance Technical Order (TCTO) kit materiel costs are also included in this category.

A. PROCESS DESCRIPTION

Maintenance materiel costs are collected by the Standard Base Supply System (SBSS), D002A. Base supply transaction records are selected and summarized monthly by SRD, and passed to the VAMOSC Component Support Cost System (CSCS), D160B. The D160B System selects records with aircraft-related SRDs and passes the remaining records to D160A. To allow for the fact that any given TMS can have more than one assigned SRD, the C-E system calculates the maintenance materiel costs by TMS as follows [12]:

$$S_j = m_{1j} + m_{2j} + \dots + m_{mj}$$

$$M_k = S_1 + S_2 + \dots + S_n$$

where m_{ij} = consumable base maintenance materiel costs for SRD_j
at base i, from D002A via D160B,

S_j = the Air Force-wide total consumable base maintenance materiel costs for SRD_j,

and M_k = the total Air Force-wide consumable base maintenance materiel costs for TMS_k.

The above algorithm is based on the following assumptions [12]:

- (1) D002A will accurately collect base maintenance materiel costs by SRD.
- (2) The TMS-NSN Table will be accurately maintained to relate SRDs to the appropriate TMSs.
- (3) All standard base supply systems use the proper SRDs for materiel transactions.

The algorithm is constrained in that only costs for TMSs with assigned SRDs will be captured.

It should be noted that the programs used by D002A to select maintenance materiel costs for the VAMOSC system are modifications of programs written originally to extract costs for both investment and expense materiel for the Base Maintenance Cost System (MCS) [8,9]. The following criteria are currently used to select daily base supply transactions for issues, turn-ins, and local manufacture receipts:

- (1) Type Organization Codes [6] of 7, 8 or 9,
 - (2) SRD codes: Axx, Bxx, Cxx, Exx, Fxx, Jxx, Kxx, Qxx, SMx, SPx, Uxx, Xxx, lxx, 2xx, 3xx, 4xx, 5xx, 7xx, and 8xx,
 - (3) Financial Inventory Accounting (FIA) codes [8]: 31x, 330, 331, 334, 440, 441, 42x, 572, 664, and 681 (codes 3xx, 572, and 664 are charges and are added, while codes 4xx, and 681 are credits and are subtracted),
 - (4) Type Account Codes: B(supplies) and E(equipment),
- and (5) Non-EAID (Equipment Authorized Inventory Data) equipment transactions with an Authority for Issue Indicator E, AF Form 780 equipment (for example, small tools and inexpensive equipment that is not centrally controlled).

Turn-in transactions are edited to exclude such things as items found on base and repair-cycle items that are repaired. Note that the number of unrepaired exchange items are counted at turn-in time, not issue time. After records are selected they are assigned type materiel codes (TMCs) as follows:

- (1) For type organization code 8 stock fund transactions,
TMC = 7.
- (2) For type organization codes 7 and 9:
 - (a) TMC = 1 for local manufacture stock fund transactions, and non-aircraft or missile related SRD transactions (i.e., C-E SRDs),
 - (b) TMC = 2 for bench stock transactions with aircraft or missile SRDs,
 - (c) TMC = 3 for other stock fund transactions with aircraft or missile SRDs,
 - (d) TMC = 5 for investment transactions for TCTO kits (K in 5th position of stock number).

It should be noted that repair-cycle transactions are not assigned a TMC and therefore are not passed on to the VAMOSC system. The daily base transaction records with TMC 1, 2, 3 and 7 are summarized by SRD, adding the extended costs and setting the quantity and NSN fields to blank. Records with TMC 5 are summarized only by quantity within NSN. The costs remain unit costs and the NSN fields remain unchanged. These summary records are written as daily detail records which are summarized monthly and sent to D160B. For detail records with a blank NSN field, the extended costs are added for each SRD. For records with a nonblank NSN field, the quantities are added together for each NSN/SRD match.

B. EVALUATION

As stated before, the SBSS interface programs for MCS were modified to get consumable maintenance materiel costs for the VAMOSC system. One of the changes was to add a list of VAMOSC SRDs to identify which records should be selected. Also, the logic was changed so that only stock fund transactions and investment TCTO kit transactions were assigned TMCs, thus eliminating the other investment materiel costs.

1. Selection Logic Omissions

The current selection of transactions with Type Organization Codes 7, 8, and 9 which collects maintenance materiel costs for organizations included in the MCS does not collect most of the C-E costs. The Office of VAMOSC queried C-E maintenance organizations to see what type organization codes are used. The responding organizations use Type Organization Codes G, I, blank, and 9, with the majority of them using G, I, and blank. Therefore, the Office of VAMOSC is in the process of having the existing selection criteria changed to include G, I, and blank. Also, the assignment of TMCs may have to be changed to include these additional type organization codes. This change cannot affect the FY83 C-E Operating and Support Cost Reports, since FY83 materiel costs have already been extracted from SBSS transaction records.

Several problems exist with selecting maintenance materiel costs directly by SRD. These result in the loss of maintenance materiel costs. The current SRD selection criteria do not include SRD 6xx. Since SRD 6A2 and 6A3 are end items which are to be costed by the C-E system, as

indicated by their inclusion in the TMS-NSN Table, the selection process in the D002A interface must be changed to include them. Also, some common bench stock items may not have application SRDs assigned. In practice, if a base supply customer does not know the application SRD he may use a ZZZ or other incorrect SRD. Furthermore, routine transactions do not require an SRD. All these transactions with missing or invalid C-E SRDs can be selected using other criteria and reported as indirect materiel costs (discussed in the next section).

2. Indirect Materiel Costs

Indirect materiel costs would include expensed common maintenance materiel, general office supplies and equipment, and other materiel not directly related to a TMS. One way of obtaining these costs is by selecting those SBSS transaction records without SRDs or with invalid SRDs. The interface program would have to be changed to summarize this data at the organizational level (by the organization code in the document number) rather than at the base level. The C-E system would then require a table to match the SBSS organization code to a PAS. All of these stock fund materiel costs should then be summarized by the corresponding PAS and allocated to TMSs based on ratios of operations and maintenance personnel strengths as discussed in the Administrative Personnel Cost section of Volume I [14].

Indirect materiel costs should be obtained as described above only for C-E organizations. Desmatics does not recommend trying to obtain indirect materiel costs for non-C-E organizations with C-E equipment,

since most materiel costs for these organizations would be related to non-C-E functions. Indirect materiel costs can either be reported in a separate category or added to the Maintenance Materiel cost category. The definition of this cost category would then have to be changed to reflect this.

3. Investment TCTO Kit Materiel Costs

Base level investment TCTO kit materiel costs are included in the maintenance materiel cost category. The C-E system currently does not process these costs correctly. In addition, investment TCTO kit costs do not properly belong in this category.

The SBSS interface program summarizes investment TCTO kit materiel costs differently from other materiel costs. The cost field for these TCTO kits is a unit cost not a total cost field. The total cost must be obtained by multiplying the unit cost by the quantity field before summing the costs for the SRD. At this stage transactions containing TCTO information can be identified as having a non-blank NSN field. Currently the C-E algorithm does not treat these records differently than other materiel cost records. If the quantity field is greater than one the costs for these additional kits will be lost. The Office of VAMOSC should implement the logic to identify TCTO records so that total costs may be calculated before summing to the appropriate SRD.

By definition the costs included in the Maintenance Materiel cost category involve only expensed materiel. Investment TCTO kit materiel costs do not fit this definition. In addition, the Cost Analysis Im-

provement Group (CAIG) guidelines [1] suggest that investment modification kit materiel costs be given separate visibility along with other investment materiel costs in the Sustaining Investment category. Therefore, Desmatics recommends that the investment TCTO kit materiel costs incurred at base-level be moved to the Replacement Investment category and be given separate visibility along with depot-level modification kit costs (which will be discussed in the next deliverable in this series).

4. Future SBSS Changes

In the process of implementing the addition of the missing Type Organization Codes, the Office of VAMOSC determined that all existing base supply programs are in the hands of a contractor for conversion to new Phase IV computers, which will be installed at bases over the next several years. The old programs can be converted immediately, and corrected materiel costs will start appearing on FY84 reports. However, it was too late to have the new programs modified before the first system is installed in 1983 at Langley AFB. Therefore, costs for Type Organization Codes G, I, and blank and for SRD 6xx will be lost temporarily for bases with new computer systems until the contractor implements the change. Since this problem is unavoidable, the Office of VAMOSC should state the problem and its effect on materiel costs in a history of changes given to users along with the O&S reports.

Maintenance materiel costs for four bases, McClellan, Kelly, Hill, and Robins, are not collected by the SBSS; therefore, no maintenance

materiel costs will be collected for the end items at C-E organizations at these bases. Since these bases are scheduled to be part of the SBSS with the implementation of Phase IV computers, Desmatics suggests that the Office of VAMOSC consider an interim measure to collect these costs. This could be done by selecting materiel costs from ABDS (EEICs 60xxx-63xxx with the exception of 612 which is included in fuel costs), for C-E organizations. These costs may be allocated to the C-E organizations' TMSs by ratios based on maintenance manhours. Although these ABDS costs would include direct and indirect materiel costs, Desmatics contends that this is appropriate since this is only an interim measure. It should be noted that C-E organizations which have the same OAC/OBAN would have to be treated as a single unit for cost allocation purposes.

Desmatics has observed that the existing SBSS interface is unnecessarily complex since it is an adaptation of a program originally written for the MCS. Much of the logic involves selecting transactions for investment materiel which VAMOSC does not require. Also, the logic assigns the materiel costs to five categories and then, with the exception of investment TCTO kit costs, sums them together again. Since this program runs daily at every SBSS worldwide, its efficiency should be considered. It would be easier to maintain a less complex program which applies more directly to the requirements of VAMOSC processing.

VI. CONCLUSIONS. RECOMMENDATIONS, AND OFFICE OF VAMOSC COMMENTS

This volume has presented an evaluation by Desmatics of the C-E system's cost allocation algorithms for the three areas presently defined by the system as Unit Level Consumption costs: Utilities, Fuel, and Maintenance Materiel. The evaluation included a study of the internal tables used for FY82 test runs.

A. SUMMARY

In Desmatics' opinion, the present utilities algorithm could result in a misstatement of utility costs. The 24-hour operating time assumption should be verified. In addition base utility rates and power requirements must be more accurately and consistently obtained.

The current fuel algorithm for mobile equipment is difficult to implement because of the universal nature of generators. Desmatics proposes an alternative algorithm for mobile equipment based on the power consumption of these TMSs. The proposed algorithm can also be used to allocate fuel costs for equipment in C-E organizations at remote and regular sites.

The current maintenance materiel cost allocation algorithm does not correctly process investment TCTO kit materiel costs. Desmatics recommends removing these TCTO kit costs from the maintenance materiel category and including them with depot level modification kit costs in the Replacement Investment cost category. Also, it has been determined that the interface with SBSS is currently not capturing most of the C-E

consumable materiel costs. Desmatics suggests including a new cost category, Indirect Materiel costs, under Unit Level Consumption.

B. RECOMMENDATIONS AND REPLIES

This section lists Desmatics' conclusions and recommendations regarding the C-E Unit Level Consumption cost allocation algorithms. The responses or comments of the Office of VAMOSC are included.

1. The Utilities Cost Category Name and Definition (See pages 6-7)

Conclusion: The current Utilities cost category name is ambiguous because the word "utilities" commonly refers to other things besides electricity. In addition, the definition of this category does not indicate that power costs for electricity produced by fuel consuming generators are excluded.

Recommendation: This cost category should be renamed Electric Utilities and be redefined to emphasize that it includes only the costs of purchased or centrally produced electricity.

Office of VAMOSC Comments: "Concur. The title and AFR 400-31 will be changed accordingly for FY84 reports."

2. The 24 Hour Operating Time Assumption (See pages 7-8)

Conclusion: The 24 hour, 365 day a year operating time assumption could cause a significant overestimation of utility costs if a number of end items operate less than that.

Recommendation: The Office of VAMOSC should examine this assumption by conducting a study to determine average operating times for end items powered by purchased or centrally produced electricity. This data would provide an indication of the magnitude of any overestimation. Further action (if any) by the Office of VAMOSC can be based on this information.

Office of VAMOSC Comments: "Concur. Based upon our experience, most end items do operate 24 hours a day, 365 days a year. For those that are questionable, we will attempt to complete this study during FY85."

3. Electric Utility Costs for Mobile Equipment (See pages 8-9)

Conclusion: The utility algorithm as modified for FY82 does not include electric utility costs for mobile equipment in garrison.

Recommendation: The Office of VAMOSC should consider including the electric utility costs for mobile equipment in garrison in the electric utilities category. This will require the reporting of operating times (e.g., on the C-E Unit Level Report) for this equipment when powered by purchased or centrally produced electricity.

Office of VAMOSC Comments: "Concur. Although no data system presently exists that provides this information, we hope to obtain the required information during the study mentioned in paragraph two (above). Implementation date can be no earlier than FY86 reports."

4. Electric Power Consumption Data from TOs (See pages 9-10)

Conclusion: The assumption that the power consumption figures based on TOs provide a reasonable estimate of the actual power consumed by TMSs is tenuous.

Recommendation: The Office of VAMOSC should confirm that the TO power requirement figures for TMSs represent their average power consumption under normal operating conditions. If they do not, the Office of VAMOSC should consider using other methods (such as one-time metering of equipment during normal operations) to obtain better consumption estimates.

Office of VAMOSC Comments: "Concur. We will examine the standards used for producing TO power requirements to determine if these figures are suitable for electric utility cost calculations. If they are not, measures will be taken to obtain better figures."

5. Base Utility Rates (See pages 10-12)

Conclusion: Base utility rates are required for all locations except for remote sites where the C-E organizations use fuel to generate their own power. Presently, rates are not available for some of the non-remote locations.

Recommendation: The Office of VAMOSC should pursue its intent to identify remote sites. Estimated rates could then be used for non-remote sites with missing rates.

Office of VAMOSC Comments: "Concur. Estimated completion date (ECD) is Jan 85 for FY84 reports."

6. Inclusion of Standard Power Consumption on C-E Reports (See page 12)

Conclusion: The electric power consumption rates used in the C-E utilities algorithm would provide additional useful information to users of the C-E system.

Recommendation: The Office of VAMOSC should consider including the electric power consumption rate for end items on the C-E Operating and Support Cost Reports.

Office of VAMOSC Comments: "Concur in principle. Our users are provided our TMS-NSN table which includes this information. Although no one has requested that this data appear on the O&S cost report, we will add this information to the history file at some convenient future time."

7. Definition of Fuel Costs (See page 16)

Conclusion: The definition of fuel costs given in the C-E User's Manual does not include all the types of fuel currently (and legitimately) selected for costing.

Recommendation: The Office of VAMOSC should redefine fuel costs for the C-E system as "the allocated share of a C-E organization's total fuel costs."

Office of VAMOSC Comments: "Concur. This change will be included in the forthcoming update to AFR 400-31, Vol. III."

8. Fuel Factor Operating Time Assumption (See page 18)

Conclusion: The current and proposed fuel allocation algorithms are based on the assumption that an organization's TMSs all operate the same amount of time while using generators. This assumption may not be valid in all cases.

Recommendation: The Office of VAMOSC should test this assumption by collecting average operating times for TMSs powered by generators (e.g., on the C-E Unit Level Report). If this information indicates that this assumption is invalid, it will be necessary to provide operating time estimates in the algorithm.

Office of VAMOSC Comments: "Concur. We expect this information will be available as a result of actions taken under items two and three of this report."

9. A Proposed Fuel Algorithm (See pages 16-19)

Conclusion: The current two-step method for computing fuel factors for mobile equipment is difficult to implement and is not producing accurate allocations. Desmatics proposes a one-step method which can also be used to allocate fuel costs for C-E organizations at remote and regular sites.

Recommendation: The Office of VAMOSC should consider replacing the current fuel algorithm with the one proposed. This algorithm should also be used to allocate fuel costs for remote and regular C-E organizations, but should not be used to allocate fuel costs for non-C-E organizations. At these organizations most fuel use would involve non-C-E functions.

Office of VAMOSC Comments: "Concur. ECD March 1985 for FY84 reports."

10. Maintenance Materiel Selection Logic (See pages 23-24)

Conclusion: Base level maintenance materiel costs are being lost because of omissions in the current selection logic in the D002A interface.

Recommendation: The Office of VAMOSC should insure that interface program with D002A is changed to include transactions with Type Organization Codes G, I, and blank. The program also be modified to include transactions with SRDs of the 6xx.

Office of VAMOSC Comments: "Concur. ECD March 1985 for reports."

11. Indirect Materiel Costs (See pages 24-25)

Conclusion: Indirect materiel costs are not currently included or displayed on the C-E O&S report. In Desmatics' opinion these costs are relevant and should be included.

Recommendation: The Office of VAMOSC should have the interface with D002A modified to select indirect materiel costs, and the C-E system modified to allocate these costs to TMSs. The allocated costs should either be included as a separate entry on the C-E O&S report, or added to the maintenance materiel cost category with a corresponding change to the definition of this category.

Office of VAMOSC Comments: "Concur in principle. We agree indirect materiel costs should be added to our base materiel report. We will explore the best means for doing this."

12. Maintenance Materiel Costs Not Collected by the SBSS (See

Conclusion: Maintenance Materiel costs for C-E organizations at four bases, Kelly, McClellan, Hill, and Robins, are currently not collected by the SBSS. An interim measure is required to collect these costs until these bases are included in the SBSS.

Recommendation: The Office of VAMOSC should consider terminating the current method of obtaining maintenance materiel costs for C-E organizations at these four bases from the Accounting and Budget Distribution System (ABDS), H069R, and allocating them to TMSs based on maintenance man-hours.

Office of VAMOSC Comments: "Concur in principle. These costs are important; however the Phase IV interface will be available. When this methodology could be implemented. We will reevaluate the conclusion should resources within the AFLC/LM function be available."

13. Investment TCTO Kit Materiel Costs (See page 25)

Conclusion: The C-E system does not properly process investment TCTO kit materiel costs from the SBSS interface, with the result that some of these costs are lost. It presently uses the unit cost, not the extended cost, for final summarization.

Recommendation: The Office of VAMOSC should implement the changes necessary to compute total investment TCTO kit costs.

Office of VAMOSC Comments: "Concur. Action has already been taken to have this item corrected. ECD is Jan 85."

14. Recategorization of Investment TCTO Kits (See pages 25-26)

Conclusion: Investment TCTO kit materiel costs should not be included in the Maintenance Materiel cost category since this category includes expensed materiel only. In addition, the CAIG guidelines classify these costs as sustaining investment.

Recommendation: The Office of VAMOSC should include these base-level investment TCTO kit materiel costs with depot-level modification kit materiel costs in the Replacement Investment cost category.

Office of VAMOSC Comments: "Concur. ECD Jan 85 for FY84 reports."

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